Effectiveness of the mulligan mobilization technique in mechanical neck pain

Mulligan mobilization in neck pain

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Abstract

Aim: The aim of this study was to investigate the effectiveness of Mulligan Mobilization technique in participants with mechanical neck pain. Material and Method: A total of 40 participants (35 female, 5 male) aged between 25 to 50 years were included the study. Participants were randomly divided into two groups as Mulligan Mobilization group and control group. The participants in both groups received home exercise program. The participants were treated 10 times for two weeks. Pain (Visual Analog Scale), muscle strength (stabilizer pressure biofeedback, Hand Held Dynamometer), range of motion (universal goniometer) pain threshold (algometer), disability level (Neck Disability Index), quality of life (Nottingham Health Profile), depressive symptoms (Beck Depression Inventory), cervical performance level (cervical performance tests) were measured at baseline, after the treatment program and repeated 1 month and 3 months after the end of the treatment. Results: In both groups' pain intensity, pain threshold, muscle strength, performance level, the range of motion, disability, depression, and quality of life improved after the treatment program ($p<0.05$). Discussion: The results of this study showed Mulligan Mobilization treatment program has positive effects on pain, the range of motion, muscle strength, performance level, disability, depressive symptoms, and quality of life in participants with mechanical neck pain.

Keywords

Mechanical Neck Pain; Mulligan Mobilization; Efficacy

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Introduction

Neck pain is the second most common musculoskeletal complaint among the general population that induces financial burden on both person and society. One out of every three people can suffer from neck pain in a period of life for various reasons. It has been reported that 26-71% of adult population experience neck pain or tenderness at least once during their life [1].

Various factors such as postural disorders, traumas, and emotional problems may play a role in the development of mechanical neck pain (MNP). Although the pathology of MNP is not precisely known, it is thought to be associated with a variety of anatomical structures including intervertebral joints, neural tissues, discs, muscles, and ligaments [2].

Manual therapy methods, physiotherapy practices, exercise, medical therapy, injection, and patient training have an important place in the treatment of MNP. MNP treatment, in which mobilization techniques are applied, has been reported to bear better results than other treatment techniques. The Mulligan mobilization technique (MMT) has been indicated to be useful for correction of biomechanics and reduction of pain during activity in case of musculoskeletal disorders [3].

This study was performed to investigate the effectiveness of the MMT in the treatment of patients diagnosed with MNP.

Material and Method

This study was carried out on 40 patients (35 female and 5 male), who were diagnosed with MPN and aged between 25-50 years. Before the introduction of treatment, all participants were informed about the study; their oral and written consents were obtained. The study was approved by Pamukkale University Faculty of Medicine Ethics Committee (PAU.0.20.05.09/ 04). This work was supported by Pamukkale University Scientific Research Projects Coordination Unit (2012SBE003).

The participants were randomized into two groups as Mulligan mobilization receiving group and control group by placing the patients into groups in order of arrival. The first group received MMT plus exercise while the second group was given home exercise program only. Each group consisted of 20 people. Treatment was planned as 10 sessions to be performed on 5 days per week for 2 weeks.

A form to record the socio-demographic characteristics of the cases was prepared. In this assessment, various factors including age, height, body weight, body mass index (BMI), education level, pregnancy, smoking, and sleep pattern were considered.

In the supine position, the distance between the acromion and bed was measured bilaterally and recorded while the distance between the 5th cervical vertebra and the wall in the upright posture was measured and recorded.

Cervical range of motion was measured using universal goniometer according to Kendall-McCreary criteria. Flexion, extension, lateral flexion, and rotation motions of the cervical region were measured for three times in the sitting position, and the average of the measurements was recorded.

The strength of the deep cervical muscles was evaluated with the stabilizer pressure biofeedback device. The patient was placed in supine position, and the device was placed under the nape without inflating the pressure cell. Afterwards, the cell was inflated up to 20 mmHg without pushing it to the cervical region. The patients were then asked to practice posterior cervical tilt. The pressure applied to the cell was recorded in mmHg.

A handheld dynamometer was employed to measure the isometric strength of cervical muscles. We assessed cervical flexion, extension, right/left lateral flexion and muscle strength via the dynamometer. The measurements were carried out while the participant was sitting on a chair. The probe of the device was placed in front of the head for cervical flexion, behind the head for extension, to right side for right lateral flexion and to left side for left lateral flexion; and the participant was requested to push his/her head main towards the direction of the probe without disrupting the position of the body. That measurement was repeated for two times for both directions and the average strength at the time of the disruption of body position was recorded in kilograms.

Cervical muscle performance test was performed using a chronometer in cervical flexion, extension, and right and left lateral flexion directions.

For cervical flexion muscle performance test, the participant was asked to put his/her jaw to retraction position while she/he was in supine position and then to pick up and hold his/her head, keeping the retraction position. The duration of the ability to keep the position was recorded in seconds, and 60 seconds were considered insufficient muscle endurance.

For the cervical extension muscle performance test, the participant was asked to maintain his/her neck in extension while she/he was in prone position. Moreover, cervical lateral flexion muscle performance test the participant was told to raise the head from the bed and hold it in lateral flexion while resting in the lateral position. The performance tests were evaluated as follows: 20-25 sec: functional, 10-19 sec: moderate functionality, 1-9 sec: poor functionality and 0 sec: non-functional. Each test was performed three times with required resting intervals, and the average of the tests was recorded.

Recorded data included the duration of pain (month), the factor(s) inducing pain, and the location of pain. The severity of pain was evaluated with Visual Analog Scale in three categories, namely during activity, during resting and at night.

Algometer was applied to measure occipital-frontal circumference, paravertebral and spinous processes, the circumferences of the back and scapula. The algometer probe was placed perpendicular to the skin, and then the participant was asked to mention the time when she/he first would feel pain after starting the application of pressure. Measurements were repeated for three times with resting intervals, and the average of the measurements was recorded.

We used the Neck Disability Index to assess disability of our participants. The NDI was developed in 1989 by Dr. Howard Vernon, and the reliability and validity of its Turkish version was tested by Aslan et al. in 2008 [4]. The index consists of 10 items referring to various factors: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. Each of the 10 items scores from 0 to 5 (0: the best situation, 5: the worst situation). The patients were asked to mark one single statement that most closely described their problems. In the present study, as some sections (driving, work) of the 10-item questionnaire were left empty by the patients,

the mean neck disability score was calculated by dividing the total score by the number of responded questions. Additionally, the percentage of neck disability may be calculated by duplicating the total raw score. The total score ranges from 0 to 50 indicating no disability and complete disability, respectively. A patient's score is interpreted as follows: 0–4 = No disability; 5–14 = Mild disability; 15–24 = Moderate disability; 25–34 = Severe disability; 35 or over = Complete disability.

We analyzed the patients' quality of life using the Nottingham Health Profile (NHP), which was adapted into Turkish by Küçükdeveci et al. in 2000 [5]. The NHP contains 38 questions grouped into six domains: physical mobility (eight items); social isolation (five items); emotional reactions (nine items); pain (eight items); sleep (five items); and energy (three items). Each question is answered "yes" or "no". While "no" is scored for zero, "yes" is scored for one. Each question assigned a weighted value; the sum of all weighted values in a given subarea adds up to 100 where a score of 0 indicates good subjective health status and 100 indicates poor subjective health status. The NHP total score is obtained by averaging the six domain scores.

Depressive symptoms of the participants were evaluated using the Beck Depression Inventory (BDI), the Turkish version of which was shown to be valid and reliable by Hisli in 1989. BDI consists of 21 multiple choice questions. Each item is scored from 0-3 [6]. The total score for the whole test would range between zero and sixty-three. The scores are interpreted according to the following guide: 0-9 points = minimally depressive symptoms; 10-16 points = mildly depressive symptoms; 17-29 points = moderately depressive symptoms; and 30-63 points = severely depressive symptoms.

In the MMT Group, the patients received 3 sets of MMT, each set involving 10 times repetition of the exercise. The interval between the sets was 15 to 20 seconds. The patients were trained about the self-mobilization techniques and asked to practice these 3 sets three times a day within the scope of home exercise program. The patients received therapy in the sitting position. A physiotherapist applied passive motion to facet joints at each spinal level. By applying passive manual pressure on cervical vertebrae in translation or rotation directions without causing pain, the participant was asked to make active movements in all directions that she/he did not feel pain. At the final angles of the joints, either the participant or a physiotherapist applied pressure.The control group applied a home exercise program for 5 days of a week during two weeks. The exercise program involved 3 sets of ROM exercises including neck flexion, extension, right/left lateral flexion along with stretching exercises for upper trapezius, posterior part of deltoid and pectoral muscles to be practiced three times a day with ten repetitions. Telephone interviews were conducted to check whether the participants perform the home exercises or not. All participants were invited to the hospital for follow-up examinations at the end of treatment and the end of the 1st and 3rd months after treatment, and they had to do exercises during the examination.

All analyses were performed with the SPSS (version 15.0) statistical package program. Results for continuous variables were given as mean ± standard deviation and categorical variables were given as number and frequencies. Data were analyzed by using two independent samples t-test, paired samples t-test, and Mann–Whitney U-test. The statistical significance was considered at 0.05.

Results

A total of 40 patients with mechanic neck pain were included in the study. Demographic variables of the participants are provided in Table 1. No statistical difference was found between the groups regarding demographic data (p<.05) (Table 1).

In-group comparison of pre-treatment and post-treatment measurement parameters is given in Table 2. While there was a favorable change in all measurement parameters of the Mulligan Mobilization group after treatment (p=0.0001), the patients in the control group showed improvement in the parameters of pain severity, pain threshold (except for trapezius and infraspinatus muscles), ROM, cervical flexion performance test, NDI and BDI (p<0.05) (Table 2).

Table 3 shows the inter-group comparison of the measurement parameters at the end of the 3rd month after treatment. There was a statistically significant difference between the groups regarding all measurement parameters in favor of the Mulligan Mobilization group (p=0.0001) (Table 3).

Discussion

Cervical region is the most common site for spinal disorders. MNP is a non-radicular pain originating from local musculoskeletal structures. MNP is characterized by the spasm of cervical muscles caused by trauma and posture dysfunction. While its prevalence is reported as 67% during lifetime, MNP can result in severe pain and disability [7].

Cervical pain is more common in middle age and among women [8]. Whereas there is not a comprehensive study on the prevalence of neck pain in Turkey, the prevalence of neck pain was reported to range from 20.5% to 47.8% among employees [9]. The prevalence of neck pain in general population was reported to be 13% in women and 9% in men [10]. In a study that Erdine

Table 1. Baseline Characteristics of the Participants

Baseline	Intervention Group	Control Group	
Characteristics	(n=20)	(n=20)	p-Value*
Gender (n %)			
Female	17 (85)	18 (90)	
Male	3 (15)	2 (10)	0.63
Age (yr)	33.35±6.09	34.25± 8.66	0.70
BMI (kg/cm^2)	23.21±2.85	24.28± 2.92	0.24
Education			
Uneducated	1 (5)	1 (5)	
Mandatory	5 (25)	10 (50)	
High School	8 (40)	3 (15)	
University	6 (30)	6 (30)	0.29
Marital Status			
Single	14 (70)	15 (75)	
Married	6 (30)	5 (25)	0.72
Occupation			
Working	13 (65)	10 (50)	
Not working	7 (35)	10 (50)	0.33

BMI: Body Mass Index; *: Mann-Whitney U test, x^2 test

Table 2. Comparison of measurement parameters before and after treatment within the group.

Variables Intervention	Group (n=20)			Control Group (n=20)		
	Before treatment Mean±SD	After treatment Mean±SD	p*	Before treatment Mean±SD	After treatment Mean±SD	p*
Pain Intensity (cm)						
VAS activity	72.75±15.95	14.65±12.69	0.0001	67.95±16.50	57.95±17.44	0.001
Pain Threshold						
M. Trapezius	6.91±3.23	9.78±3.77	0.0001	8.54±7.50	8.40±2.71	0.77
M. Levator scapula	8.19±2.89	11.32±3.30	0.0001	10.23±3.13	9.56±2.92	0.033
M. Teres Major	7.78±2.86	10.82±2.98	0.0001	9.92±3.29	9.50±3.14	0.017
M. Supraspinatus	7.78±2.92	10.62±2.99	0.0001	8.94±2.55	8.69±2.67	0.049
M. İnfraspinatus	7.36±3.27	10.47±2.90	0.0001	8.33±2.49	8.03±2.56	0.130
Muscle Strengt (mmHg)						
Deep extensor muscle	29.25±10.75	39.60±10.48	0.0001	30.55±8.97	30.25±7.68	0.432
Range of Motion (º)	39.65±9.04	59.65±5.68	0.0001	44.45±7.29	47.25±8.68	0.014
Cervical flexion	37.30±3.79	49.60±1.98	0.0001	40.75±7.62	43.20±7.40	0.0001
Cervical extension	29.15±5.26	38.80±2.69	0.0001	31.97±4.79	34.87±4.37	0.0001
Cervical lateral flexion	41.40±5.21	53.87±1.64	0.0001	44.52±5.88	46.77±5.68	0.0001
Cervical rotation						
Cervical Performance Tests(sn)						
Flexion	21.20±10.56	40.65±12.56	0.0001	26.55±14.91	29.90±16.72	0.007
Extension	39.30±21.89	54.00±10.71	0.003	45.45±14.38	43.70±15.63	0.55
Lateral flexion	25.45±18.53	44.20±16.77	0.0001	34.25±16.92	34.32±18.41	0.95
NDI 15.00±5.54	2.90±3.12	0.0001	13.50±5.06	11.50±5.18	0.0001	
BDE 8.85±5.32	1.20±1.54	0.0001	7.95±4.85	6.90±4.96	0.002	
NHP 175.21±97.95	69.89±50.96	0.0001	152.23±111.92	152.63±110.31	0.49	

VAS: Visuel Analog Scale; M: Muscle; NDI: Neck Disability Index; BDE: Beck Depression Envantory; NHP: Nothingham Health Profile; SD: Standard Deviation; *: Paired Sample t-test

et al. [11] conducted in 15 provinces of Turkey, the prevalence of pain was indicated to be 63.7%. It was also stated by Erdine et al. [11] that pain was more prevalent in western and middle Anatolia, in city centers, among those aged 35-44 years and among women; and 76.6% of the pain was chronic. Similar to the studies in the published literature, the number of female participants was higher than that of male participants in our study (35 women, 5 men).

Studies have indicated that manual therapy methods like the MMT are effective in the treatment of MNP [12]. The impact of MMT on the reduction of pain and improvement of functions can be seen instantly after treatment. The Mulligan concept is a painless application when performed correctly and clinically indicated. The Mulligan Mobilization involves SNAGs (Self-sustained Natural Apophyseal Glide), NAGs (Natural Apophyseal Glides) and mobilization techniques. These techniques are considered as a useful device in the treatment of neuromuscular pain and dysfunction [13].

Vicenzo and Wright] found that pain of a patient with lateral epicondylitis decreased by 36% after 10 weeks following the application of 4 sessions of MMT [14]. In addition to the studies reporting that application of mobilization techniques for non-specific neck pain resulted in better outcomes as compared to placebo groups, there are also studies indicating that mobilization methods are more effective than electrotherapy and massage.

There is evidence supporting that cervical mobilization practices can help reducing pain while increasing functionality and patient satisfaction in case of mechanical neck disorders. Addition of exercise to these practices was reported to further increase the efficiency of treatment [15]. In twenty-seven studies involving a total of 1522 patients with mechanical neck pain, a comparison was made between mobilization and medical therapy, acupuncture, hot application, electrotherapy, massage, and control groups. As a result, mobilization was found to provide higher relief regarding pain and functionality as compared to other methods. Furthermore, mobilization and manipulation did not show any adverse effect that may lead to a neurological deficit [16]. In a systematic review consisting of nineteen studies, mobilization and soft tissue techniques were compared with physical modalities. As a result of both short-term and long-term follow-ups, evidence was obtained supporting that mobilization scaled down pain but enhanced functionality and patient satisfaction in participants suffering from mechanical neck pain.

In this study, we identified that MMT improved VAS scores in case of cervical pain at the end of treatment and this improvement maintained in the 3rd month after treatment. This improvement can be explained by the fact that with MMT application, the joint is restored to normal and positional error is corrected, and the pain during activity is reduced by repositioning the bone structures and providing restoration of movement. In a study investigating the impact of MMT on pressure pain threshold and range of motion (ROM) on 24 patients aged 20-64 years with painful and limited shoulder movement, range of motion enhanced by 42% at the end of 4-10 session therapy and one month after therapy, the improvement of ROM was 22%, and that of pain threshold was 20.2% [17]. Moreover, pain

Table 3. Comparison of after treatment measurement differences between groups.

	Variables Intervention Group (n=20) Mean ± SD	Control Group (n=20) Mean ± SD	p*
Δ1 Pain Intensity (cm)			
VAS activity	56.5 ± 20.23	2.25 ± 20.54	0.0001
Δ1 Pain Threshold			
M. Trapezius	-2.12 ± 1.64	0.49 ± 1.36	0.0001
M. Levator scapula	-2.08 ± 1.60	1.08 ± 1.77	0.0001
M. Teres Major	-2.18 ± 1.35	1.01 ± 1.97	0.0001
M. Supraspinatus	-2.24 ± 1.00	0.54 ± 1.79	0.0001
M. İnfraspinatus	-1.91 ± 1.59	0.88 ± 1.45	0.0001
Δ1 Muscle Strength (mmHg)			
Deep extensor muscle	-8.1 ± 6.28	1.40 ± 5.08	0.0001
Δ1 Range of Motion (º)			
Cervical flexion	-19.9 ± 8.86	-0.10 ± 2.04	0.0001
Cervical extension	-11.85 ± 3.67	0.65 ± 1.59	0.0001
Cervical lateral flexion	-9.55 ± 4.91	0.40 ± 2.11	0.0001
Cervical rotation	-12.25 ± 5.42	-0.45 ± 2.79	0.0001
Δ1 Cervical Performance Tests(sn)			
Flexion	-12.55 ± 14.74	3.70 ± 9.83	0.0001
Extension	-11.85 ± 13.67	0.45 ± 4.89	0.0001
Lateral flexion	-18.00 ± 13.86	1.42 ± 7.47	0.0001
Δ1 NDI	11.15 ± 6.25	0.50 ± 1.00	0.0001
Δ1 BDE	8.05 ± 4.90	0.60 ± 1.04	0.0001
Δ1 NHP	23.57 ± 9.49	-1.59 ± 7.48	0.0001

Δ1: Differences in measurement between pre-treatment and after 3 months.; VAS: Visual Analog Scale; M: Muscle; NDI: Neck Disability Index; BDE: Beck Depression Inventory; NHP: Nottingham Health Profile; SD: Standard Deviation; *: Two Independent sample t-test

threshold of the trapezius, levator scapulae, teres major, supraspinatus and infraspinatus muscles further elevated at the end of the treatment as compared to the control group, and this elevation was observed to continue three months after treatment. MMT is a treatment method based on providing painless restoration of normal motion and function of joints and surrounding soft tissues. According to the general principles of the Mulligan therapy, all techniques should be applied in a way that avoids pain and eliminates pain within a short time. The aim is to restore painless movement in joint [18], and therefore, eliminating pain in the muscles is the priority. The increase in the range of motion of the group treated with MMT was achieved by correcting joint biomechanics with MMT, which was combined with active motion. This increase was also observed in the measurements performed in the 3rd month of follow-up.

In patients with chronic neck pain, deep neck flexor muscles do not produce sufficiently effective contractions during movement. Jull et al. [19] conducted a 6-week training program involving strengthening exercises for forty-six patients with chronic neck pain subjects, and EMG examinations performed after treatment indicated an increase in the strength of deep flexor, sternocleidomastoid and anterior scalene muscles [19]. In our study, moreover, muscle strength of the extensor muscle group showed a higher increase in the MMT-receiving group as compared to the control group both at the end of the treatment and three months after treatment. These outcomes may be have resulted from the fact that MMT was applied in combination with exercises; pain during activity was deducted by elevating the stimulus given to the muscles through the application of stretching at the end of the movement, which resulted in the production of normal contraction power of cervical muscles. In a study by Jette and Jette], mobilization and manipulation were identified to minimize disability according to the Neck Disability Index (NDI) on 358 patients with MNP [20]. Hoving et al. included patients that had suffered from neck pain for less than 12 weeks and made a comparison between a 1st group receiving spinal mobilization practices for 6 weeks and a 2nd group receiving medical therapy plus home exercises. At the end of an 8-week follow-up, Hoving et al. decided that mobilization was more effective in lowering pain and disability [21]. Similarly, we found MMT application to be more beneficial in decreasing disability at the end of treatment and 3 months after treatment as compared to the control group exercises. As a result of the improvement of functional status in parallel to the reduction of pain with MMT, participants were able to perform their daily activities more easily and without pain.

Considering the results of 17 randomized controlled studies analyzed by Miller et al., applying mobilization for cervical pain yielded favorable outcomes in reducing pain and increasing the quality of life and body functions both in short and long terms [22].

The quality of life improved at the end of treatment and 3 months after treatment in the MMT-receiving patients as compared to the control subjects. We believe that the MMT had a positive effect on the patients' quality of life by decreasing cervical pain, improving muscle strength, enhancing pain threshold at trigger points and bettering the functional state.

Some studies in the literature argued that mobilization applied on the cervical region lowered depressive symptoms of patients [23]. In our study, we observed that depressive symptoms of the patients in the mobilization group showed a decrease at the end of the treatment and that improvement went on in the 3rd month of follow-up. We think that reduction of pain and enhancement of the quality of life as a result of the MMTs influenced the decrease of the depressive symptoms.

It has been determined that MMT influenced ensuring normal muscle function. With MMT, the joint returns to its normal location, and thus, the positional error is corrected. The restoration of the movement aims to reposition the bone. Performing the movements with smooth biomechanics enhances the performance of surrounding muscles [24]. In this study, we observed an increase in cervical muscle performance of the MMT group at the end of the treatment as compared to the control group, and moreover, that increase continued even in the 3rd month following the treatment. In the control group, however, the performance increase in muscle strength was maintained for 3 months only in the flexion direction but returned to pre-treatment levels in other directions.

When it comes to the limitations of our study, the follow-up period is short, and the study was not designed as a single-blinded study.

The strengths of our research are randomized controlled design, validity and reliability of all questionnaires used in the study, and short to medium term follow-up.In conclusion, MMT

has therapeutic effects in the treatment of MNP such as increasing the range of motion of the joint, reducing pain and increasing muscle strength and functioning and eventually reducing the depressive symptoms of the patients and increasing the quality of life.

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Contributorship information
Concept development (provided the idea for the research): T.D.
Design (planned the methods to generate the results): T.D., N.Y.
Supervision (provided oversight, responsible for organization and implementation, writing of the manuscript): T.D., N.Y.
Data collection/processing (responsible for experiments, patient management, organization, or reporting data): T.D.
Analysis/interpretation (responsible for statistical analysis, evaluation, and presentation of the results): T.D., N.Y.
The literature search (performed the literature search): T.D.
Writing (responsible for writing a substantive part of the manuscript): T.D., N.Y.
The critical review (revised manuscript for intellectual content, this does not relate to spelling and grammar checking): T.D., N.Y.

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The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

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All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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